

# Chicken Tractor (Optimized Construction and Design)

From Appropedia

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## Status

This OSAT has been designed but not yet tested - use at own risk

# Introduction

Chicken tractors are commonly used all over the world as mobile chicken coops, however they have not been given much engineering attention. They are almost always developed in a trial and error fashion and therefore there is an opportunity for their design to be optimized.

## Purpose

The Purpose of a Chicken Tractor is to use it as a passive tilling system for a tract of land. The chickens living inside the tractor walk, pick, and eat off the grass. They also defaecate in the same area, all the activity tills up the shallow surface of the soil and reduces the plant and insect population. By moving the tractor every few days all the soil in an area is slowly tilled and fertilized.

## Optimized Design

The complete 3D CAD is available, however it is a Autodesk Inventor file, and is not posted online yet. It can be accessed by request through the discussion section.

## Overview

The chosen design was optimized to meet the requirements set out in the Design Requirements section, it can be seen bellow.

## Step Overview 1.jpeg



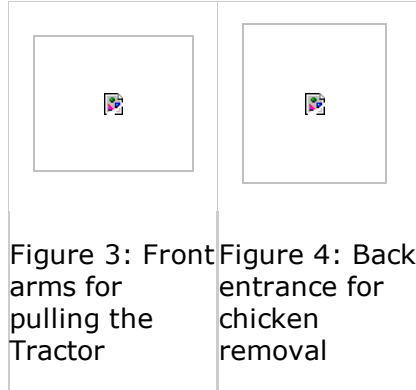
The Chicken Tractor is split into 2 main sections, the outdoor section enclosed with only chicken wire, and the interior section enclosed by two plywood walls and covered by a tarp of some sort. The two sections were designed large enough to hold four chickens at any time, leaving the chickens 4 Sq-ft of space each. The exterior section is meant for use during the day, the chickens can get sun, they can walk on the grass, pick seeds and defecate outside, this turns up the shallow surface of the ground like a tractor does. At night, or during unfavorable weather the chickens can move into the enclosed section, where they will be protected from the elements.

Having two sections in the design allows for much more flexibility than a one chamber system. The overall design is friendly to modifications towards either; more sheltering or openness. Using a tarp or other light plastic for the covering material has many advantages, particularly the simplicity of removing or attaching it. If the size of the enclosed area needs to be changed (increased, or decreased) for any reason it is very simple to do, the entire Tractor can become enclosed by a tarp during rainy seasons, or the tarp can be removed during hot dry periods. The floor for the enclosed section can also be modular; by not permanently attaching it, the grass area of the Chicken Tractor can be doubled, as seen in figure 2.

## Step Overview 2.jpeg



Although the design is very large the system is still mobile, which is critical for the concept of a Chicken Tractor. This design, which kept costs to a minimum, did not include wheels or an axle and is dragged along on it's side supports like a sled. A possible location for an axle and wheels are located at the back and with additional money a more complex movement system can be installed. However the current configuration, with someone using the arms at the front to pull the system along does not require excessive force.



## Functional Specifics

The Chicken Tractor is to be used for housing chickens, they can enter through a movable wire flap in the front or in the rear of the structure. The whole system is designed to move with chickens inside or outside. The front of the Tractor is lifted up and pulled with the arms. The system doesn't need to move far, just enough to get to a new section of grass for the chickens to use. The system should be moved every few days depending on the size and number of chickens inside.

## Force Analysis

The forces on the Chicken Tractor are being evaluated to determine how much effort will be required to move it. It is assumed the system will be lifted from one end and dragged on the back tracks, so the whole thing makes an angle with the ground. The free body diagram for the system can be seen bellow in figure 5.

The sum of the forces is taken in the Y-direction knowing that there is no acceleration, since the object is not moving up or down, the sum of the forces must equal zero.



The force of gravity can also be written as gravitational acceleration multiplied by mass.



[1]

The sum of the forces is taken in the X-direction, since the object will be pulled at a constant velocity the sum of the forces will be equal to zero.



The force of friction can also be written as the normal force times the coefficient of friction,  $0.62^{[1]}$  was used for the coefficient of friction between the object and the grass, based on the value between wood and concrete.



[2]

The sum of the moments is taken about point A, this point cannot support a torque, therefore the moment,  $M$  at that point must be equal to zero.



[3]



Figure 5: Free Body Diagram of Chicken Tractor

Equations 1, 2 and 3 can be simultaneously solved for  $F_x$ ,  $F_y$  and  $F_N$ . The total force required to move the Chicken Tractor is calculated as the resultant of the forces in the X and Y direction.



The dimensions of the system were optimized so that the force required to move it are minimized for a given mass. The calculated forces are shown bellow in table 1.

*Table 1: Resulting Force's on Chicken Tractor*

	<b>Force (N)</b>
X	222.7
Y	499.2
Total	546.6

## Design Requirements

There were a number of requirements for the design so that the final chicken tractor would be optimized. The following criteria were used to choose the final design.

- Mobility - The chicken tractor must be easy to move, however it also needs to be sturdy enough to withstand incremental weather conditions.
- All Season - The design must be able to keep the inhabitants warm and dry at night and during rain storms, while still remaining cool during the day. The design does not have to be able to withstand Canadian winters as it is intended for warmer climates.

- Spacious - The design must be able to accommodate between 3-4 grown chickens, at 4 Sq-ft per chicken.
- Affordable - The design must cost less then \$60.00 CAD to fully construct.
- Flexibility - Easily modified for different needs.
- Locally available - All the materials must be locally available.

## Construction and Assembly

To be able to fully construct the Chicken Tractor basic knowledge of Carpentry (<http://en.wikipedia.org/wiki/Carpentry>) will be required. The complete construction requires, sawing, hammering, framing and other basic carpentry skills.

## Required Materials

Shown bellow in table 2 is a list of all the materials that are needed to construct the Chicken Tractor, along with the approximate cost of all the items.

**Note:** These are only guidelines and different materials can be substituted where appropriate.

*Table 2: Required Materials*

Material	Number Required	Use/Alternatives	Total Cost (CAD)
Chicken Wire		Only need 5ft by 9ft in total is really needed , netting is not	\$10.00



48"x50'	1	suggested as chickens can rip through it easily	[2]
1/4" Plywood sheet 4x8	1	Plywood in used for the floor and front/back entrances, other wood or sheet metal can be substituted if available	\$6.87 [3]
2X4's 10 ft	3	Wood is the material of choice for the framing, however different sized wood thinner/thicker pieces can be used instead of 2X4's	\$12.00 [4]
Nails/Screws	50	Bolts could be substituted for nails, however they are less available and harder to work with	\$12.00 [5]
Staples	500	Small nails can be used instead of staples to hold down the chicken wire, however this is more work and harder to accomplish	\$14.99 [6]
Tarp	1	Any rain resistant covering can be put over the enclosed section of the Chicken Tractor	\$5.99 [7]
		Total	\$61.85

(Note: This is only possible if materials are split with others, costs will be higher if materials have to be bought at double the required amounts.)

## Required Tools

To construct a Chicken Tractor you will need access to a number or tools. Shown bellow in table 3 are the tools that are required, and what they will be used for, so that alternative tools can be used where possible.


*Table 3: Required Tools*

<b>Tool</b>	<b>Possible Alternative Tool</b>	<b>Use</b>
Hammer or drill for screws	Mallet, or hard piece of metal, a screw driver is not suggested for screws.	Nailing 2x4 framing together
Saw	Anything that can cut large pieces of wood	Cutting 2x4's and plywood to length, shaping plywood
Staple Gun	Hammer, mallet or any blunt edge	Attaching the chicken wire to the wood frame

## Construction

Shown bellow in table 4 is a list of all the different pieces that will be needed to construct the Chicken Tractor, they are co-located with dimensional drawings so that they can be easily produced.

*Table 4: Parts*

<b>Part</b>	<b>Dimensional Drawings</b>
Bottom Frame	 <p>Fig 6: Bottom Frame</p>

Complete Chicken Wire Casing



Fig 7: Complete  
Chicken Wire  
Casing

Cross Support






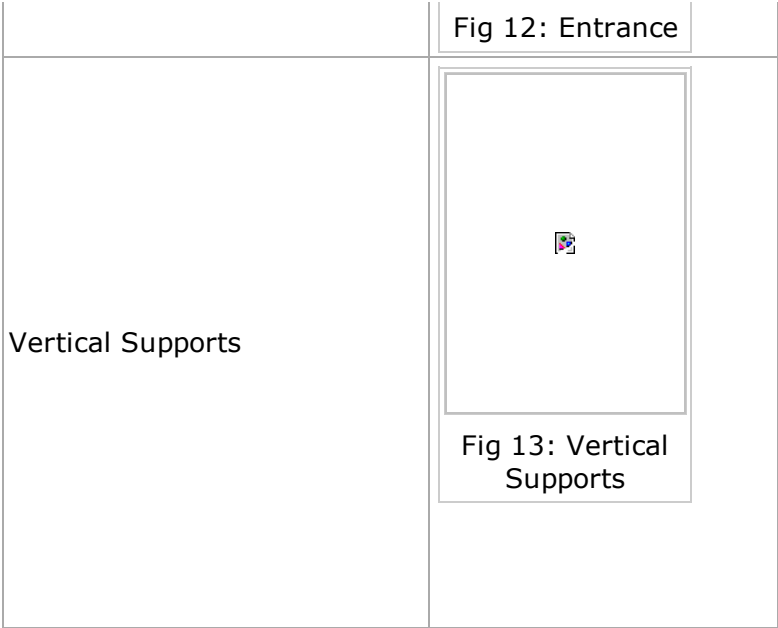
Fig 8: Cross  
Support

Door Cover



Fig 9: Door Cover

Floor Sheet	 Fig 10: Floor Sheet
Front Cross Support	 Fig 11: Front Cross Support
Entrance	












Assembly

Once all the pieces have been cut to the proper length it is possible to begin assembly. Follow the steps in table 5 to construct the Chicken Tractor.

Table 5: Assembly

Step #	Required Parts	Instructions	Figure
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1	Bottom Frame	Layout the 2 pieces as shown in the figure.	 Fig 14: Step 1
2	Cross Support, Front Cross Support	Layout the 2 pieces as shown in the picture. Using screws or nails attach the pieces together.	 Fig 15: Step 2
3	Floor Sheet	Layout the floor sheet as shown in the figure and nail down, or leave unattached for a larger grass section.	 Fig 16: Step 3
4	Vertical Supports	Screw or nail the vertical supports down into position so that they are centered and securely attached.	 Fig 17: Step 4
5	Entrance	Screw or nail the 3 entrances in, as shown in the figure.	 Fig 18: Step 5

6	Door Cover	Attach the two door covers using nails or staples. Attach on one side so they can hinge open for the chickens.	
7	Complete Chicken Wire Casing	Unroll the chicken wire to surround the frame as shown in the figure, attach along the Bottom Frame with staples or nails and anywhere else that is appropriate.	 Fig 19: Step 6  Fig 20: Step 7
8	Cover	Cover the floor section chicken wire with a tarp, as shown in the figure.	 Fig 21: Step 8

## Regional Considerations

The Chicken Tractor can be utilized in any region that can support an outdoor chicken habitat during a few months of the year. The design was intended for warmer climates so that it can be used all year round. If the tractor was used in cold climates the chickens would need a separate location to live in during the winter months, as it was not designed to shelter chickens in the winter.

Also it should be noted that the tractor does take some effort to move every few days. Those that build it should be aware that there is physical labor involved with day to day use.

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